Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

CSAS | **SCCS**

Canadian Science Advisory Secretariat | **Secrétariat canadien de consultation scientifique**

Proceedings Series 2012/056 | **Compte rendu 2012/056**

Pacific Region | **Région du Pacifique**

Proceedings of the Regional Peer Review Meeting on information in the support of critical habitat identification for Cultus Pygmy Sculpin (*Cottus aleuticus*)

October 12, 2011
Nanaimo, BC

Sean MacConnachie
Chairperson

Compte rendu de la réunion régionale d'examen par les pairs au sujet de l'information à l'appui de la désignation de l'habitat essentiel du chabot pygmée (*Cottus aleuticus*)

Le 12 octobre 2011
Nanaimo (Colombie-Britannique)

Sean MacConnachie
Président

Fisheries and Oceans Canada / Pêches et Océans Canada
Science Branch / Secteur des Science
3190 Hammond Bay Road
Nanaimo, BC V9T 6N7

April 2013 | Avril 2013

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

© Her Majesty the Queen in Right of Canada, 2013
© Sa Majesté la Reine du Chef du Canada, 2013

ISSN 1701-1272 (Printed / Imprimé)
ISSN 1701-1280 (Online / En ligne)

Published and available free from:
Une publication gratuite de :

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique
200, rue Kent Street
Ottawa, Ontario
K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/

CSAS-SCCS@DFO-MPO.GC.CA

Correct citation for this publication:

DFO. 2013. Proceedings of the Regional Peer Review Meeting on information in the support of critical habitat identification for Cultus Pygmy Sculpin (*Cottus aleuticus*). DFO Can. Sci. Advis. Sec. Proceed. Ser. 2012/056.

TABLE OF CONTENTS

SUMMARY IV
SOMMAIRE IV
INTRODUCTION 1
REVIEW 2
Presentation of working Paper 2
Questions for clarification 2
Written Reviews 2
GENERAL DISCUSSION 3
CONCLUSIONS 4
RECOMMENDATIONS & ADVICE 4
ACKNOWLEDGEMENTS 4
REFERENCES 4
APPENDIX A: TERMS OF REFERENCE 5
APPENDIX B: AGENDA 6
APPENDIX C: ATTENDEES 7
APPENDIX D: WRITTEN REVIEWS 8

SUMMARY

These Proceedings summarize the relevant discussions and key conclusions that resulted from a Fisheries and Oceans Canada, Canadian Science Advisory Secretariat (CSAS) Regional Advisory meeting on October 12, 2011 at the Pacific Biological Station in Nanaimo, B.C. One working paper focusing on recommendations for critical habitat for Cultus Pgymy Sculpin was presented for peer review.

In-person and web-based participation included Fisheries and Oceans Canada Science and Ecosystems Management Branch staff; and external participants from the Province of British Columbia and academia.

The conclusions and advice resulting from this review will be provided in the form of a Science Advisory Report providing advice to the Species at Risk program to inform the identification of critical habitat for Cultus Pygmy Sculpin as a requirement under the Species at Risk Act for species that are listed as threatened or endangered.

The Science Advisory Report and supporting Research Document will be made publicly available on the CSAS Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

SOMMAIRE

Le présent compte rendu résume les discussions et l'essentiel des conclusions issues d'une réunion de consultation scientifique régionale du Secrétariat canadien de consultation scientifique (SCCS) de Pêches et Océans Canada (MPO), qui s'est tenue le 12 octobre 2011 à la Station biologique du Pacifique de Nanaimo, en Colombie-Britannique. Un document de travail portant sur les recommandations relatives à l'habitat essentiel du chabot pygmée a été présenté aux fins d'examen par les pairs.

Au nombre des personnes qui ont participé à la réunion en personne ou par cyberconférence, il y avait des membres du personnel de la Direction générale de la gestion des pêches et de la Direction générale de la gestion des écosystèmes ainsi que des participants externes de la Colombie-Britannique et du milieu universitaire.

Les conclusions et les avis découlant de cet examen seront présentés sous la forme d'un avis scientifique en vue de fournir des conseils aux responsables du Programme des espèces en péril et de faciliter la désignation de l'habitat essentiel du chabot pygmée en vertu d'une exigence de la *Loi sur les espèces en péril* relativement aux espèces inscrites comme étant menacées ou en voie de disparition.

L'avis scientifique et le document de recherche à l'appui seront rendus publics dans le calendrier des avis scientifiques du SCCS à l'adresse suivante : http://www.dfo-mpo.gc.ca/csas-sccs/index-fra.htm.

INTRODUCTION

A Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS), Regional Advisory Process (RAP) meeting was held on October 12, 2011 at the Pacific Biological Station in Nanaimo to review the information needed to identify critical habitat as described under SARA. Since April 2003 the Cultus Pygmy Sculpin has been listed as a threatened species under the SARA. As such, critical habitat for the species must be identified in the Recovery Strategy or Action Plan based on the best information possible.

The Terms of Reference (TOR) for the science review (Appendix A) were developed in response to a request for advice from the Species at Risk program. Notifications of the science review and conditions for participation were sent to representatives with relevant expertise from First Nations, the province of British Columbia and academia.

The following working paper was prepared and made available to meeting participants prior to the meeting:

The identification of critical habitat for Coastrange Sculpin (Cultus Population) (*Cottus sp.*) by Eric Chiang, Gerrit Velema, Dan Selbie, Jeremy Hume, Tom Brown and Patricia Woodruff. (CSAP Working Paper 2011/P34).

The meeting Chair, Sean MacConnachie, welcomed participants, reviewed the role of CSAS in the provision of peer-reviewed advice, and gave a general overview of the CSAS process. The Chair discussed the role of participants, the purpose of the various CSAS publications (Science Advisory Report, Proceedings and Research Document), and the definition and process around achieving consensus based decisions and advice. Everyone was invited to participate fully in the discussion and to contribute knowledge to the process, with the goal of delivering scientifically defensible conclusions and advice. It was confirmed with participants that all had received copies of the Terms of Reference, working papers, and draft SARs.

The Chair reviewed the Agenda (Appendix B) and the Terms of Reference for the meeting, highlighting the objectives and identifying the Rapporteur for the review. The Chair then reviewed the ground rules and process for exchange, reminding participants that the meeting was a science review and not a consultation. The room was equipped with microphones to allow remote participation by web-based attendees, and in-person attendees were reminded to address comments and questions so they could be heard by those online.

Members were reminded that everyone at the meeting had equal standing as participants and that they were expected to contribute to the review process if they had information or questions relevant to the paper being discussed. In total, 15 people participated in the RAP (Appendix C). Dr. Chris Wood was identified as the Rapporteur for the meeting.

Participants were informed that Dr. Jordan Rosenfeld had been asked before the meeting to provide detailed written reviews for the working paper to assist everyone attending the peer-review meeting. Participants were provided with copies of the written review.

The conclusions and advice resulting from this review will be provided in the form of Science Advisory Report to the Species at Risk program to inform species at risk recovery planning. The Science Advisory Report and supporting Research Document

will be made publicly available on the CSAS Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

REVIEW

Working Paper: The identification of critical habitat for Coastrange Sculpin (Cultus Population) (*Cottus sp.*) by Eric Chiang, Gerrit Velema, Dan Selbie, Jeremy Hume, Tom Brown and Patricia Woodruff. (CSAP Working Paper 2011/P34).

Rapporteur: Chris Wood
Presenter: Eric Chiang

PRESENTATION OF WORKING PAPER

Questions for clarification

A question arose about the Columbia valley land use – crops vs. livestock? Agriculture has shifted towards crops (berries) and away from livestock (now less hog farming and associated problems with manure), but there is still a broad mix of activities.

A participant inquired about the origin of the 20-m depth cutoff. The cutoff was based on observations that Cultus Pygmy Sculpin (CPS) were almost never trapped above 20 m but commonly below this depth.

Is there any knowledge of spawning depth in any other lacustrine Coastrange sculpin (or any other lacustrine sculpin) population? No, only ~8 gravid CPS have been found, all caught below 20 m and within 10 m of bottom in south end of lake

COSEWIC was very cautious in its interpretation of the evidence for a declining trend in abundance (see the paragraph in the COSEWIC status report), and its interpretation seems to have been misrepresented in this report.

Can potential riparian function be considered as CH, or left open as a possibility? Even though CPS appears to be deepwater species, potential use of habitat affected by riparian zone has not been ruled out for identification of critical habitat (e.g., perhaps larvae use the littoral zone)?

Have the effects of hydrocarbons or toxic effluents been considered? An author responded that they thought these effects are unlikely to threaten the CPS but agrees that they should be included as an unknown but potential threat (chronic rather than acute). A participant suggested that fish and habitat samples should be examined during a high use period of recreational boating activities to see if there is a measurable impact.

Is it possible to distinguish between activities (leaks from septic fields, application of fertilizer) and the consequences of those activities (eutrophication)? No, not without a targeted monitoring plan.

WRITTEN REVIEWS

Jordan Rosenfeld gave his presentation (see Appendix D).

A discussion ensued about how CPS are planktivorous despite negative buoyancy, an unusual attribute in Coast Range Sculpin (CRS). Lacustrine populations of CRS are very rare, and only occur in productive lakes, therefore it's reasonable to infer that suitable circumstances for their evolution are rare, and that abundance of *Daphnia* is a critical factor for the evolution and persistence of CPS in Cultus Lake.

GENERAL DISCUSSION

Should the list of activities likely to destroy critical habitat be exhaustive? We must consider both likelihood and severity. These include all activities we can think of now, for example, list aquatic invasive species (probable) vs. activities in littoral zone (possible); much of the lakeshore is in the park, so the probability of harmful activities in the littoral zone is low.

A recommendation was made to add a column to table 3 to reflect severity and likelihood of the threat. But how would that information used to identify Critical habitat? The identification of critical habitat implicitly involves risk assessment (policy). Another recommendation was to also mention threats that have been eliminated.

A recommendation was made that required values for Dissolved Oxygen and other limnological parameters could be given as ranges that appear to have been acceptable (from Shortreed 2007). Can summarize and cite results rather than re-presenting results. This links to a requirement to support *Daphnia* as critical attribute.

Highest current nutrient levels could be considered as close to the upper limit for CPS given occurrence of blue-green algae and thermal stratification in summer, which suggests that water transparency could change quickly with further nutrient. Alternatively, the paper could specify that nutrient loading should not be increased despite not being able to provide a specific upper threshold on safe level.

A recommendation was to infer CH for CPS by investigating differences between lakes that have lacustrine CRS and those that don't (despite being accessible to CRS). However, we don't know what food larval CPS requires.

Even if deleterious consequences of nutrient loading on CH are expected to increase because of interactions with climate change, anthropogenic sources of nutrients can (should) still be managed.

A recommendation was made that sockeye trawl data should be analyzed from perspective of spatial and depth distribution of sculpins. Spatial distribution cannot be resolved because trawls extend the length of the lake, but could examine depth distribution by examining catches in trawls at different depths.

A discussion to place regarding the size distribution of sculpins by trawl depth and timing of catches by depth (evidence for diel migration?); catch rates appear to have been relatively high (sometimes >1/min in Fig 3), so looks to be a potentially rich source of insight about pelagic activity; if trawl surveys are not considered useful, the paper should provide a better explanation of why they are not useful or why potentially misleading. Also plot trend in abundance on log scale to stabilize variation and better reveal any declining trend; how many CPS have been caught by trawl (pelagic) versus trap (benthic) and are the individuals bigger or smaller in traps?

This report implies that Eurasian milfoil is neutral for CPS but European research indicates that milfoil produces toxins that might be detrimental to food chains (e.g., *Daphnia*), so reconsider possibility that milfoil is not ecologically neutral. Perhaps milfoil indirectly harms CPS through its positive effect on Pikeminnow (by providing refuge for young Pikeminnow from cannibalism by large Pikeminnow). Do Pikeminnow eat CPS? One author responded that depth distributions overlap and bull trout do eat CPS; both predators eat juvenile sockeye. What about activities to control/remove milfoil and do such activities warrant mention in Table 3?

A discussion tool place about inlet streams might subsequently affect the lake? Protection for inlet streams seems adequately covered by examples in Table 3. But a recommendation was made to insure that AIS is added to Table 3.

A participant asked if there is any evidence that gravel, cobble, or boulder attributes exist at depth in benthic zone feature. The authors suggested that was doubtful - more likely that spawning occurs in gravel, cobble, or boulder substrate in littoral zone. If these attributes (and hence spawning) more likely to occur in littoral zone, then Table 1 is inaccurate and should be amended.

Need to add arguments in this report to indicate that contaminants (e.g., hydrocarbons from recreational boating, other toxic effluents) are not a plausible threat to CPS (or else should include the potential threat from contaminants as a knowledge gap in Table 2 that requires further study).

CONCLUSIONS

The paper was accepted with minor revisions.

RECOMMENDATIONS & ADVICE

Based on the best available information the entire wetted area of Cultus Lake is recommended as critical habitat for Cultus Pygmy Sculpin.

The introduction of invasive species and excessive nutrients to Cultus Lake may have a deleterious effect on Cultus Pygmy Sculpin.

Further work could be undertaken to determine the spatial and temporal distribution of the different life stages of Cultus Pygmy Sculpin in the lake and to assess if and how the lake tributaries are used.

ACKNOWLEDGEMENTS

The chair wishes to acknowledge and thank the authors for their hard work, Dr. Jordan Rosenfeld for his review, and the active engagement of the participants to improve the quality of the scientific advice. Also, thanks to Nic Dedeluk of the CSAS office for coordinating and arranging meeting logistics and managing the webinar. Thank you to Dr. Chris Wood for being the Rapporteur.

REFERENCES

Shortreed, K.S. 2007. Limnology of Cultus Lake, British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 2753: vi + 85 p.

APPENDIX A: TERMS OF REFERENCE

Terms of Reference

Identification of Critical Habitat for Cultus Pigmy Sculpin

Pacific Regional Science Advisory Process

October 12th, 2011
Nanaimo BC

Chairperson: Sean MacConnachie

Context

Cultus Pigmy Sculpin (*Cottus sp.*) was listed in 2003 as Threatened under the Species at Risk Act (SARA), and a recovery strategy for the species was completed in 2007 (National Recovery Team for Cultus Pygmy Sculpin. 2007). A recovery strategy or action plan must identify a threatened species' critical habitat, or "the habitat that is necessary for the survival or recovery of a listed species and that is identified as the species critical habitat in the recovery strategy or action plan for the species". Under SARA s41(1)(c) a species' critical habitat must be identified to the extent possible, based on the best available information.

DFO SARA Management Program has requested science advice in support of the identification of critical habitat and development of the Action Plan for the Cultus Pygmy Sculpin under SARA. A technical workshop was held in February 2011 to provide direction to the work necessary to complete this request.

Objectives

The following working paper will be reviewed and provide the basis for discussion and advice:

Chiang, E., G. Velema, T. Brown and P. Woodruff. The identification of critical habitat for Cultus Pygmy Sculpin (*Cottus sp.*). CSAP Working Paper

To provide the best available information regarding the geospatial extent of this species and the biophysical attributes, features and functions of the habitat necessary for the survival or recovery of Cultus Pygmy Sculpin.

Expected publications

CSAS Science Advisory Report (1)
CSAS Research Document (1)
CSAS Proceedings

Participation

DFO Science, Oceans, Habitat and Species at Risk, Policy and Economics
Province of BC
External Reviewers
Non-governmental organizations
Other Stakeholders

References Cited

National Recovery Team for Cultus Pygmy Sculpin. 2007. Recovery Strategy for Cultus Pygmy Sculpin (*Cottus* sp.) in Canada. *Species at Risk Act* Recovery Strategy Series, Fisheries and Oceans Canada, Ottawa, v + 21 pp.

APPENDIX B: AGENDA

Information in support of the identification of critical habitat for Coastrange Sculpin (Cultus Population) (*Cottus sp.*)

Regional Advisory Process
Centre for Science Advice Pacific

AGENDA

October , 2011
PBS Seminar Room, Taylor Building Rooms 227A&B
Pacific Biological Station, 3190 Hammond Bay Rd., Nanaimo

Chairperson: Sean MacConnachie

Working Paper to be reviewed: The identification of critical habitat for Coastrange Sculpin (Cultus Population) (*Cottus sp.*) by Eric Chiang, Gerrit Velma, Dan Selbie, Jeremy Hume, Tom Brown and Patricia Woodruff

9:30	Introductions	Sean MacConnachie
	Review Agenda & Housekeeping	Sean MacConnachie
	CSAS Overview & Procedures	Sean MacConnachie
	Review of Terms of Reference as pertains to research document	Sean MacConnachie & RAP Participants
10:00	Presentation of Working Paper	Ray Lauzier
10:45	***Break***	
11:00	Questions of Clarification	RAP Participants
11:15	Presentation of Reviews & Authors' Responses	Reviewers & Author(s)
12:00	***Lunch Break***	
1:00	Discussion and Building Agreement on Conclusions, Recommendations, Advice and Future Work	RAP Participants
3:00	***Adjournment***	

APPENDIX C: ATTENDEES

Centre for Science Advice Pacific
Regional Advisory Process Participation Plan
Meeting Title: Cultus Lake Pigmy Sculpin

Last Name	First Name	Affiliation	Participation Oct-12
DFO Participants			
Brown	Tom	DFO Science	yes
Chiang	Eric	DFO SARA	yes
Curtis	Janelle	DFO Science	yes
Hume	Jeremy	DFO Science	yes
Joyce	Marilyn	DFO CSAS	yes
Johnson	Mark	DFO Community Advisor - Cultus Lake	on phone
MacConnachie	Sean	DFO Science	yes
Nantel	Martin	DFO SARA	yes
Pon	Lucas	DFO Science	yes
Selbie	Dan	DFO Science	yes
Wood	Chris	DFO Science	yes
External Participants			
Biffard	Doug	BC Parks	yes
Hirner	Joanna	BC MNRO; BC Parks	yes
Rosenfeld	Jordan	UBC / BC Ministry of Environment	yes
Taylor	Eric	UBC	yes
Woodruff	Patricia	UBC	yes

APPENDIX D: WRITTEN REVIEWS

Review – Cultus Pygmy Sculpin Critical Habitat Working Paper
Oct. 11, 2011
Jordan Rosenfeld

Overview: This is a generally balanced and well-written synopsis of the features that constitute critical habitat for Cultus Pygmy Sculpin. I have no major concerns with any of the content, and my main comments are that there should be a bit more profile given to the potential impacts of alien species (particularly zebra or quagga mussels) on critical habitat, a brief rationale for why riparian does not qualify as critical habitat should also be added, and more thought should probably go into the table of Activities Likely to Destroy Critical Habitat to ensure that it is complete (e.g. "Deliberate or active transfer of alien invasive species" should be listed as an activity likely to destroy critical habitat). I have a number of other mostly minor comments listed below that should also be considered on revision.

Detailed comments:

1) The paper correctly identifies alien species and eutrophication as the most likely threats to critical habitat. However, while it goes into a lot of detail on the sources and potential consequences of nutrients, much less is devoted to alien species. This is perhaps understandable since there is a lot more know about nutrient sources and water chemistry and land use trends, and it is the subject of interest of some of the authours. However, a bit more consideration of the consequences of invasive sp. might be warranted (e.g. a short paragraph), particularly zebra and quagga mussels which have the potential to vastly alter planktonic production, and would likely have negative impacts on sculpin, conceivably including extinction. Similarly a little info on potential prevention approaches would be good, although this is likely best dealt with in detail in an Action Plan.

2) The Table of Activities Likely to Destroy Critical Habitat should be carefully considered to ensure that it effectively captures most major activities likely to destroy critical habitat. For example, invasives should be added as mentioned above:

Activity - Deliberate or active transfer of alien invasive species
Effect Pathway – Contaminated boats of other recreational equipment
Function Altered – Energy flow and planktonic production
Features Effected – Food chain structure and plankton abundance
Attributes Affected – prey abundance in critical habitat

In addition, no activities are listed that will damage benthic habitat. This means, effectively, that the benthic habitat will get no real protection since no activities are identified that will damage it. This may be because there really are no current activities that are a threat, but it might be worth thinking about whether there are any potential activities that could impact benthic critical habitat. For example, large scale dredging could damage benthic critical habitat, although it's hard to imagine anyone planning that.

3) The riparian zone on the edge of the lake is not identified as critical. I think this is probably reasonable, since it is not clear that an intact riparian zone is essential to a deep-water benthic species. The only likely mechanism whereby riparian removal could negatively affect sculpin would be through effects on water quality, which would likely require extensive riparian forest removal and even then it's not clear to what extent water quality would be negatively affected and whether it would impact sculpin. Nevertheless, because riparian habitat has been identified as critical for a number of freshwater species and is clearly an important component of freshwater aquatic systems, a short rationale for why it is not included as critical habitat should be provided in the document, and the appropriate literature relevant to this should be cited (see Richardson et al. 2010. Do riparian zones qualify as critical habitat for endangered freshwater fishes? Canadian Journal of Fisheries and Aquatic Sciences 67: 1197–1204).

4) The importance of coarse substrate is referred to throughout the document, which makes sense even though this is inferred, but the size class referred to is gravel and cobble. I would suspect that boulder substrate would be equally favoured and important were it available in the lake, since substrate larger than cobble would also be likely to have abundant interstitial space that sculpin would presumably favour. I would suggest changing references to "gravel and cobble" to "gravel, cobble, and boulders" because otherwise it would suggest by omission that substrate coarser than cobble is not likely suitable or favoured, while I would suspect is not the case.

Editorial Comments:

5) Preamble – the sentence "Habitat, while important, can be affected without compromising the survival or recovery of a SARA listed species." is sweeping, simplistic, and shows a poor understanding both habitat impacts. Whether or not habitat can be "affected" without compromising survival or recovery will obviously depend on both the "affect" and the species in question. If I severely alter the habitat of the Banff Spring Snail, for example, by pouring chlorine into its habitat then it will likely not survive. If I repair a rock crib supporting a dock on the shore of Cultus Lake then it will obviously not meaningfully impacts Cultus Pygmy Sculpin. I suggest changing to:

"Some habitat can be affected without compromising the survival or recovery of a SARA listed species. Other habitats may be critical for persistence. Consequently, critical habitat….."

5) Pg 8 – Fifth paragraph at the end of Life History. Here the substrate is referred to as "gravel, cobble, or boulders", but for some reason the boulder part is dropped in later references.

6) Pg. 17, third paragraph. Are these wildlife habitat areas for Tailled Frog? Might be worth mentioning this, and roughly what features they are protecting.

7) Page 18. Suggest replacing the heading "Lake water use" (which suggests water withdrawals) to "Impacts of recreational boating and associated shoreline development".

8) Pg. 21 second paragraph – "This pattern is likely due to the bioenergetic costs associated with the species' negative buoyancy." This statement seems a little simplistic - one would imagine that they'd be where the food was if they're in the water column foraging, which would be consistent with the highest concentration of zooplankton near

the thermocline (thought this was mentioned earlier). Staying in the water column is what takes energy, and that's likely to be the same whether you're at 10m or 15m off of the bottom.

9) Pg 21. – I would insert the short rationale on why riparian doesn't qualify as critical habitat after the second or third paragraph on this page.

10) Table 1 – add boulder to attributes column. Similarly, under attributes column for feeding I suggest you be more explicit and include "(e.g. appropriate zooplankton abundance and community structure)" after "characteristics".

11) Pg. 24 top – "likely the primary habitat" – what about the water column, isn't it a primary habitat? Change to "a primary habitat" and insert "to a lesser extent" before "feeding" on line 2.

12) Pg. 24 end of 2nd paragraph. Insert ", and may be important refuge habitat at other times." Sculpin like hiding in rocks, and presumably when they're not foraging in the pelagic they're hanging out in the benthic zone somewhere.

13) pg 25, first paragraph second-third line, change to "However, any deviation or long-term trends…"

14) Many citations are missing from the References section.